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PRUNING WOUND HEALING

ON WESTERN WHITE AND PONDEROSA PINES

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In artificial pruning for the production of quality lumber the time required for the wounds to heal is of particular importance. Production of knot-free wood commences only when pruning wounds have closed. The information on rate of pruning wound healing reported here has been obtained as a by-product of tests in progress to determine the amount of decay caused by fungi entering through pruning scars.

EXPERIMENTS

The following factors affecting the rate of wound healing were selected for study:

1. Method of pruning; removing the branch collar (close pruning) vs. pruning outside the branch collar.

2. Diameter of branch; pruning large vs. small branches.

3. Live or dead condition of limbs; pruning live vs. dead branches.

4. Stand density; pruning in open vs. in dense stands.

5. Season of pruning; April and May vs. September and October.

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The effects of factors 1 to 5 were determined for western white pine in three stands, and of factors 2, 3, and 5 for ponderosa pine in one stand. As ponderosa pine has no pronounced branch collar, and as only a single test was made, factors 1 and 4 did not apply.

Test areas consisted of one open and one relatively dense stand of white pine on the Deception Creek Experimental Forest, Coeur d'Alene National Forest, and a fairly open white pine stand and a relatively open ponderosa pine plantation on the Priest River Experimental Forest, Kaniksu National Forest.

The open white pine stands were in the 20-40-year age class on good to excellent sites. The dense stand was in the 40-60-year age class on a site of good quality. The ponderosa pine stand was in a 20-40-year-old plantation on a fair white pine site. The data from the two open white pine stands were combined, because their growth rates and other features were similar. The number, average d.b.h., and average annual growth 1/ of the trees in each test were as follows:

Stand density and timber type	Trees pruned (number)	Limbs removed (number)	Average d.b.h. (inches)	Average annual d.b.h. growth (inches)
Dense white pine stand	16	489	6.0	0.08
Open white pine stands	32	724	5.4	0.23
Ponderosa pine stand	16	290	5.0	0.18

The branches were removed with a 14-inch concave blade hand pruning saw. On white pine, two or more whorls on each tree were pruned by each of the two pruning methods; i.e., pruning to remove the branch collar and to leave the branch collar. The pruning method was the same for all branches in a particular whorl. All pruning cuts on ponderosa pine were made flush with the bark of the main stem.

One-half of the trees on each test area were pruned in September and October 1938. The remaining trees were pruned in April and May 1940. Five years after pruning, the trees were examined to determine the proportion of each wound which had been overgrown by newly formed wood and bark.

1/ Average annual growth from the time of pruning (fall of 1938 and spring of 1940) up to the end of the 1945 growing season.

The extent of healing was determined by sketching the unhealed portion of each wound on circles of the same diameter as the original pruning wound, and planimetering the resulting diagrams. Branch diameters were measured at a point 1 inch from the bole at the time the experiments were started.

RESULTS

Method of pruning

Pruning which removed the branch collar resulted in considerably faster wound healing than pruning which left the branch base intact (figures 1, 2) despite the fact that for a given branch diameter a larger wound resulted from close pruning than from pruning outside the branch collar. In pruning outside the branch collar the diameter of the wound was practically the same as the branch diameter. However, in close pruning the relationship of wound diameter to live branch diameter was as follows:

Diameter of branch 1 inch from bole (inches)	Diameter of pruning wound (inches)
0.2	0.4
0.4	0.7
0.6	0.9
0.8	1.2
1.0	1.4
1.2	1.7
1.4	1.9
1.6	2.2

The average area healed on wounds from dead branches in the dense stand was 16 percent greater when made by close pruning than when made by pruning outside the branch collar and 12 percent higher in the open stand (table 1). On live branches, close pruning resulted in 8 percent more wound area healed than pruning outside the branch collar.

Table 1.--Extent of healing of pruning wounds on western white pine 5 years after pruning.

Stand density	Wound area healed			
	Live branches		Dead branches	
	Collar left	Collar removed	Collar left	Collar removed
	Percent	Percent	Percent	Percent
Dense	-	-	76	92
Open	88	96	84	96

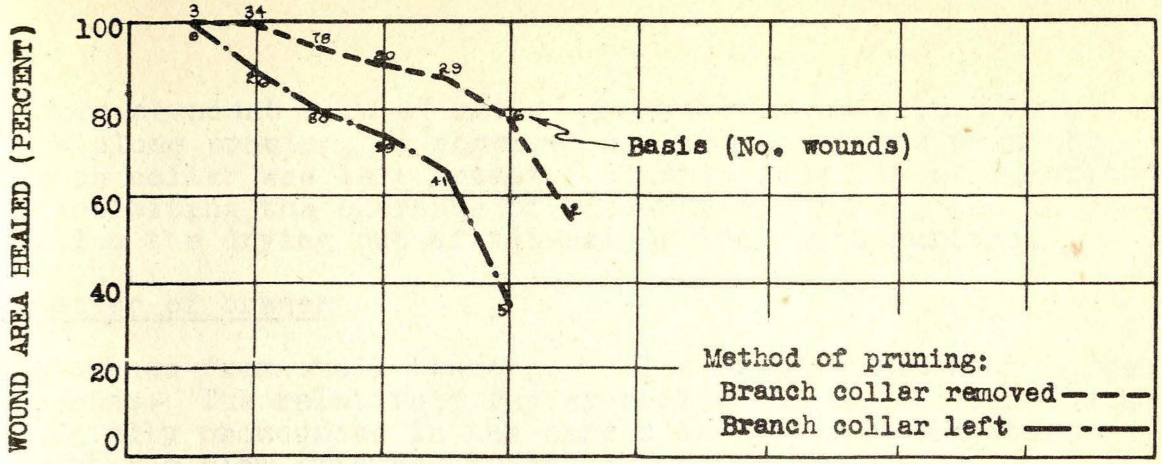


FIGURE 1.—EXTENT OF WOUND HEALING 5 YEARS AFTER PRUNING DEAD BRANCHES BY TWO DIFFERENT METHODS IN A DENSE WHITE PINE STAND.

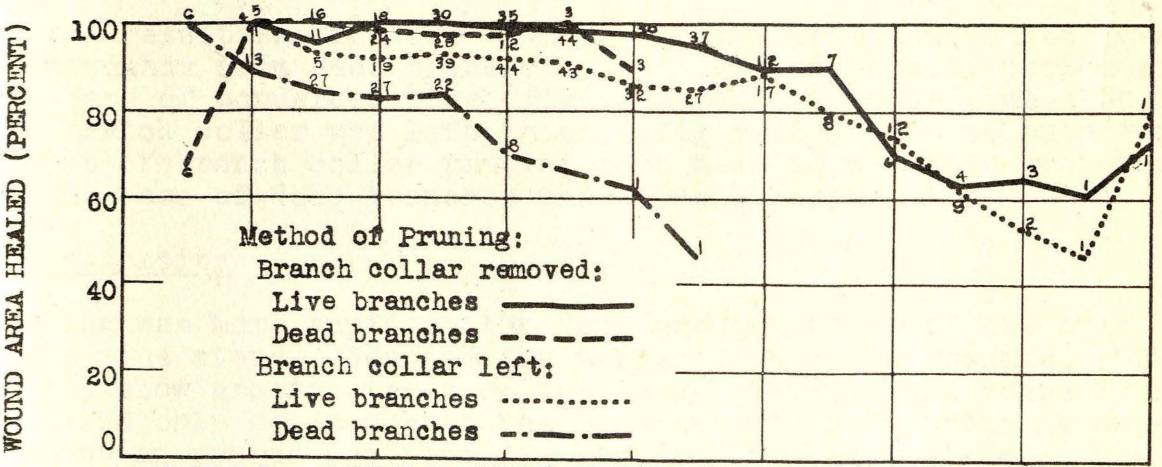


FIGURE 2.—EXTENT OF WOUND HEALING 5 YEARS AFTER PRUNING LIVE AND DEAD BRANCHES BY TWO DIFFERENT METHODS IN OPEN WHITE PINE STANDS.

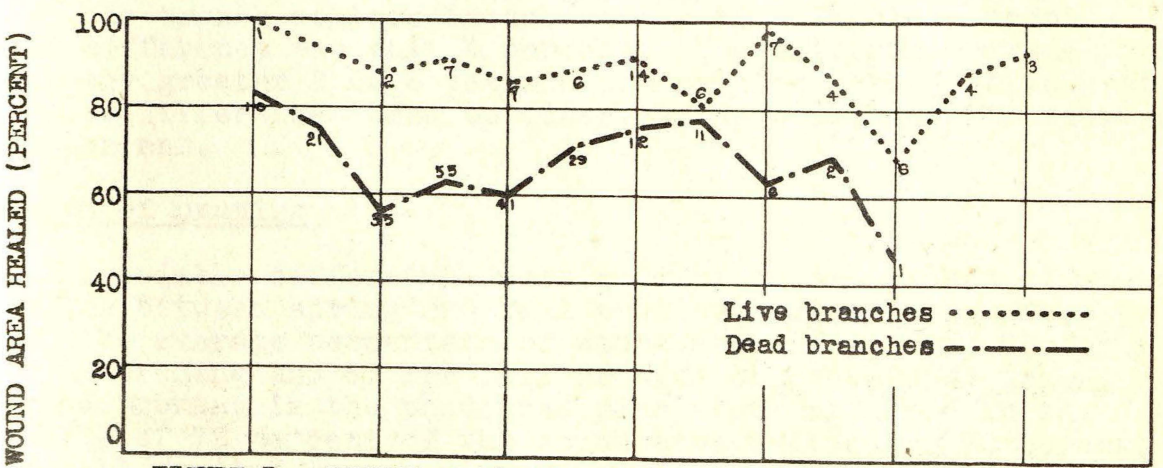
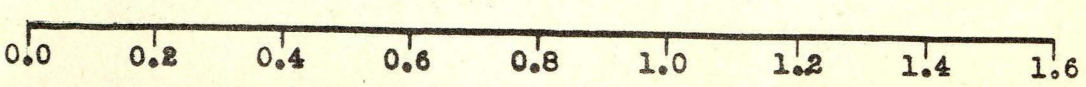


FIGURE 3.—EXTENT OF WOUND HEALING 5 YEARS AFTER PRUNING LIVE AND DEAD PONDEROSA PINE BRANCHES.



DIAMETER OF BRANCH 1-INCH FROM BOLE (INCHES)

A more abundant flow of resin was observed on wounds resulting from close pruning, as compared to flow on wounds when the branch collar was left intact. This is possibly of importance in inhibiting the entrance of wood-rotting fungi, and in preventing the drying out of tissues on the wound surface.

Diameter of branch

The wounds from small branches healed faster than from large branches. The relatively faster healing of small wounds was especially pronounced in the denser stand where diameter growth was slow (figures 1 and 2).

Live or dead condition of limbs

Wounds resulting from the removal of live branches healed faster than wounds from dead branches. This was especially marked in the case of ponderosa pine (figure 3) and on white pine when the branch collar was left intact (figure 2). The stimulating effect of branch collar removal upon healing was more pronounced in the case of dead branches than live branches.

Stand density

Healing was more rapid on the fast growing trees of the open white pine stands, despite the larger size of the wounds, than on the slow growing trees of the dense stand. This comparison is based only on dead branches because only dead branches were present on pruned sections of trees in the dense stand.

The average percentage of wound area healed was 8 percent more in the open stand than in the dense stands on prunings which left the branch collars intact (table 1). In close pruning this difference was only 4 percent. The differences were probably greater 2 or 3 years after pruning than at five years because differences tend to disappear as wound healing approaches 100 percent.

Season of pruning

No appreciable differences were evident in the extent of wound healing between spring and fall pruning. Five years after pruning, the average percentage of wound area healed was 89 for spring pruning and 87 for fall pruning on white pine trees. Spring pruning in the ponderosa pine stand resulted in an average of 72 percent of the wound area healed and 70 percent for fall pruning.

CONCLUSIONS

These experiments indicate that pruning is most effective in young plantations or in moderately open young natural stands. In such stands, pruning to a height of 17 feet (1 standard log plus a 1-foot stump) will require two or three successive operations.

Conditions affecting the rate of healing are partially compensating. In very open stands, for example, the large branches result in large wounds but the trees are relatively fast-growing and most of the branches are alive when pruned. In dense stands the trees usually grow more slowly, and most of the limbs are dead when pruned; but on the other hand, the limbs tend to be small.

Close pruning results in smaller knotty cores and more rapid wound healing. However, this method of pruning takes more time because of the larger area of the cuts, and the greater care required to cut accurately and closely.

Optimum conditions for rapid wound healing result from close pruning small live branches on rapidly growing trees.